

How should we turn data into decisions in AgriFood?

Article

Accepted Version

Serazetdinova, L., Garratt, J., Baylis, A., Stergiadis, S., Collison, M. and Davis, S. (2019) How should we turn data into decisions in AgriFood? *Journal of the Science of Food and Agriculture*, 99 (7). pp. 3213-3219. ISSN 0022-5142 doi: <https://doi.org/10.1002/jsfa.9545> Available at <https://centaur.reading.ac.uk/81194/>

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To link to this article DOI: <http://dx.doi.org/10.1002/jsfa.9545>

Publisher: Wiley

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1 Title

2 How should we turn data into decisions in AgriFood?

3 Running title

4 Turning Data into Decisions in AgriFood

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10 Abstract

11 The AgriFood supply chain is under significant pressures related to food security, climate
12 change, and consumer demands for affordable and higher quality food. Various technologies
13 are already deployed producing a large amount of data, which can be utilised to guide
14 decision-making to improve productivity, reduce wastage, and increase traceability across the
15 AgriFood supply chain. Several examples of the use of data are given, including improving
16 efficiency in livestock production, supporting automation and use of robotics in crop
17 production, increasing food safety and evidencing its provenance. The opportunities and
18 ways forward were discussed at a workshop in November 2017, run by the Society of
19 Chemical Industry and the Knowledge Transfer Network in the UK. This paper presents a
20 summary of the key messages from the presentations and focus-group discussions during this
21 event, as interpreted by the authors. A number of challenges in digitalisation of the AgriFood

supply chain are discussed, such as low inter-operability of different data sets, silo mentality, low willingness to share data and a significant skills gap. Various approaches are presented that could help to unlock the benefits of using data, from practical support to producers and addressing skills gaps, to industrial leadership and the role of government departments and regulatory bodies in leading by example. Looking forward, data are already revolutionising the AgriFood supply chain, however, the benefits will remain piecemeal until the leaders of today are able to bring together the disparate groups into a cohesive whole.

Keywords

AgriFood, supply chain, Big Data, decision support, Artificial Intelligence (AI), digitalisation

Introduction

A revolution in food production, processing and distribution is underway^{1,2,3}. Various technologies are already transforming the flow of food from field to consumer: technologies such as artificial intelligence (AI), cloud computer processing, remote sensing and robotics. Can these changes benefit the AgriFood supply chain and consumers? If so, how should we move forward? These were the questions addressed in the workshop ‘Turning Data into Decisions in AgriFood’ hosted by the Society of Chemical Industry (SCI) and the Knowledge Transfer Network (KTN) on 22 November 2017. This workshop brought together 74 professionals to hear about how these technologies are already having an impact and to consider how things might develop in the future.

Lessons can be learned from previous revolutions in farming. In the 1970s, the pioneering work of Norman Borlaug with plant breeding and nitrogen fertiliser rates led to higher yields, an expansion of irrigation and a rapid increase in mechanisation⁴.

Having enjoyed the benefits of the Green Revolution, we are witnessing the fact that the yield growth this revolution unlocked has stagnated. Between 1985 and 2005, the total global crop production increased by only 28%⁵. Whilst there are still green revolution benefits to be realised, the easy wins have been made. Thus to move forward we have to broaden the scope of the technology we deploy. Digitalisation and big data allows us to do this through enabling much more precise and targeted management of the production process.

This paper summarises the key themes of the workshop leading to an action list for how best to implement the data revolution across production and supply chains.

Drivers of change

Globally, not only is population growth projected to continue to at least mid-century, but this is combined with a rapidly expanding wealth and consumers adopting a more ‘westernised diet’ rich in protein and demanding cheaper food and increased traceability and provenance. At the same time, the growth of cities means that more sophisticated food supply chains are needed. These mega-trends create a need for greater efficiency and improved data collection, analysis and application have key roles.

The AgriFood sector is a *value network*, comprising and connecting players within their own sectors, *e.g.* farmers, various suppliers (machinery, fertiliser, crop protection, *etc.*), food processors, manufacturers, and retailers. Each component has its own drivers, objectives and issues, which interface with those of connected players and of the whole sector. For example, the importance of data technologies and sharing platforms in the livestock industry is widely recognised and includes a range of applications, such as feed production and quality, animal productivity, health, welfare, breeding and fertility, environmental footprint and product quality, traceability and marketing.

67 Current state of the industry

68 Numerous sensors and connected devices are deployed to help AgriFood companies to collect
69 data related to production, processing and distribution of products, referred to as the Internet
70 of Things (IoT). Software applications with machine learning are required to collect, analyse,
71 and integrate data, connect devices and guide decision-making. Data can help farmers to
72 optimise inputs and adjust land management regimes, which depend on many variables, e.g.
73 soil types, crop varieties and weather. Data can also help suppliers of crop protection
74 products to produce more accurate recommendations, or to gather evidence on their efficacy
75 with more precision, reducing their use and environmental impact.

76 Examples where the analysis of large volumes of data are benefiting the AgriFood sector are
77 already available. Syngenta made a commitment to the Good Growth Plan and publish
78 datasets on productivity, soil health, biodiversity, compliance with labour standards across
79 their supply chain, etc.⁶. G's Growers, one of the largest producers of salad and vegetables in
80 Europe, integrate agronomic, environmental and operational data to meet daily targets for
81 supply of iceberg lettuces which enables the them to amend production schedules to mitigate
82 against potential shortfalls (G's Growers, personal communication). IMB Research and Mars
83 collaborate to conduct the largest-ever metagenomics study to improve food safety by
84 developing an index of food-borne diseases and minimize the risk⁷. Data are being used to
85 analyse the shopping habits of millions of consumers, to help suppliers develop effective
86 marketing strategies based on purchasing patterns and demographic breakdown⁸.

87 Turning data into decisions is the key for harnessing the power of data. Examples of whole
88 food chain decisions include productivity, finance, insurance, supply chain management, food
89 security, research & development and environmental stewardship. The recent Global Open
90 Data for Agriculture and Nutrition (GODAN) review³ is highly instructive in setting the

context for the data revolution. The authors list a range of potential uses for large data sets in supporting decisions in these areas:

- Early, accurate detection and prediction of problems (pest outbreaks, resistance, water shortages, floods, low yields)
- What to grow, what treatment to apply and when to plant, treat or harvest
- Risk management (hedging, yields, insurance) and damage control (drought, pests)
- Managing subsidies (funding history, financial data)
- Informing consumers (individuals or companies)
- Fast responses to challenges

The GODAN report described key actions required to maximise the use of data in AgriFood supply chains³:

- Building trust
- Developing standards and linking data
- Ensuring sustainability
- Providing incentives
- Data publishing principles (e.g. the FAIR principles, a set of guiding principles to make data Findable, Accessible, Interoperable, and Reusable)

Similar opportunities and actions were discussed during the event itself and are described later in this paper.

[Turning Data into Decisions 2017: summary of the event](#)

In November 2017, SCI and KTN organised the event on Turning Data into Decisions in AgriFood. The purpose of the event was two-fold: firstly, to allow participants to meet each

113 other and develop their networks, and secondly, to generate discussion on the how this area
114 might develop over the coming years.

115 This event gathered over 70 representatives from crop and livestock agri-businesses, farm
116 and agronomy advisers, precision agriculture companies, machinery and equipment
117 manufacturers, companies developing and using sensors, input manufacturers, food and feed
118 manufacturers, producer organisations, agricultural traders, retail, analytical and
119 measurement services, data analysts, modellers, software engineers, robotics experts,
120 insurance providers, academics, researchers, research councils and government departments.

121 The event covered the following themes:

- 122 • Why we need data and how to make it meaningful
- 123 • Examples of data collected from sensors and connected devices, and software
124 applications for data analysis and integration
- 125 • Data analysis, integration, and the role of machine learning
- 126 • Use of data for financial models and models related to the environment and climate
- 127 • Using data for decision-making. e.g. development of software for customer interface
128 and integrating data with AgriFood practice
- 129 • Data sharing platforms and standards
- 130 • Governance around data ownership, privacy, and security

131 The morning contained presentations covering example applications of data-driven food
132 production and supply. In the afternoon the audience split into four moderated discussion
133 workshops, each with a chair and rapporteur who took notes (the rapporteurs are listed within
134 the list of authors of this paper). Each of the four workshops considered the above themes in
135 the context of specific stakeholder groups: crop and livestock production, hardware and
136 software developers, or the entire supply chain. Participants in the discussions were

137 encouraged to share their own examples and use-cases as well as their perspectives on the
138 future.

139 Thus, the opportunities, challenges and action points below are not simply the views of the
140 authors, but an amalgamation of the views of over 70 professionals in this area, as interpreted
141 and brought together by the authors with the context of the cloud of literature that is already
142 available and known use-cases. Many of the conclusions may be found in other sources^{1, 2, 3}.
143 Although our method of collecting data was different from that used by other authors, the
144 themes that emerged were not so different.

145 What opportunities exist to derive value from data?

146 It is very important to demonstrate that data could drive decision-making in food growing and
147 production with a view to meeting end-customers specifications and satisfaction. Some
148 examples of use of data follow.

149 Improving efficiency in livestock production

150 Variability in meat production systems may result in inefficiencies and reduced business
151 value. Different parameters determine efficiency during each stage of the chain: pre-birth
152 (fertility, gestation length, birth rate); rearing (growth rate, feed conversion ratio, disease
153 resistance, mortality); finishing (weight, yield, fat class); slaughter (abattoir process);
154 processing (butchery, processed meat products); and retail (meat colour, fat content, pack
155 size, price, consumer experience). The fragmented supply chain results in highly variable
156 output. Using data at key points in production, alongside tighter specifications, could help
157 analyse where most value is created and reduce inefficiencies. Sensors enable real-time
158 remote monitoring. An important target is the development of diagnostics and predictive
159 analytics for real-time data-based decision-making to optimise management strategies. A

160 growing number of professional services for dairy and meat farmers deliver hardware and
161 software applications that can automate data analysis and integrate it into farm management
162 systems and online trading platforms. These big data sets can create value to farmers when
163 incorporated in decision support tools that demonstrate the advantages of using data from
164 various key points that determine efficiency during each stage of the chain. Digital platforms
165 bring buyers and sellers together and enabling vital information to flow up and down the
166 supply chain, enabling proper comparison across multiple key indicators, improving
167 transparency and traceability.

168 Use of data to support automation and use of robotics

169 The adoption of robotics in AgriFood is becoming more urgent. Farmers and food
170 manufacturers need to produce more food to higher environmental and quality standards,
171 while experiencing severe labour shortages. Therefore, there is a huge potential in improving
172 productivity through efficiency gains that can be achieved via automation and use of data.
173 The development of ‘co-bots’, where robots work alongside humans, utilising autonomous or
174 partly autonomous behaviour is a possible option.

175 Robotic systems need data to perceive, make decisions and move. For example, the
176 harvesting process is only partially automated and is relatively inefficient. To automate a
177 process, information may be needed from several machines. To achieve higher levels of
178 automation in harvesting, rule-based systems and modelling can be deployed to optimise
179 process configuration. This can be achieved through the use of data on machine operation and
180 the development of ‘training’ data sets (Claas KGaA mbH, personal communication).

181 Increasingly, robotic platforms, besides performing manual functions, are used to collect
182 useful in-process data (in-field or during food manufacturing). Data gathered by robotic

183 systems can be especially valuable due to the ability to capture data repeatedly and
184 consistently from precise locations.

185 Food provenance and safety

186 Data could help to increase consumer trust and safety by helping to establish the provenance
187 of products and the conditions under which they have been brought to market. Data can help
188 to develop real-time prediction of emerging risks to food safety and fraud, e.g. the horsemeat
189 scandal in 2013. Data on prices of commodities, consumer price index, exchange rates,
190 extreme weather, pest and disease incidents, changes in regulation and standards, profit
191 margins, production capacities, etc. can be used to develop early warning systems for food
192 fraud. Deploying algorithms based on machine learning and statistical methods that aggregate
193 all layers of such data and detect anomalies can collectively highlight any potential issues.

194 Development of shorter supply chains and new operating models

195 Digitalisation is enabling all farmers and food companies, whether small or larger scale to
196 understand consumer needs and target higher value markets. Digital technologies could
197 facilitate development of on-line trading platforms, or virtual online co-ops. These online
198 trading platforms may also help to open-up the food market to smaller farms and food
199 producers allowing them to sell direct and bypass the main existing distribution channels.
200 Differences in purchasing behaviour between different consumer segments may be significant
201 and require special attention to guide business planning, marketing and new product
202 development. Data collected from retailers via consumer membership cards may elucidate
203 factors such as geo-demographics, retail channel and consumer lifestyles.

204 Managing risks and uncertainties in food production

205 Inelastic supply and demand in agricultural commodities create volatile prices. Farm
206 businesses succeed or fail on productivity and prices. Historically, mixed farming systems
207 with crops and livestock provided a natural hedge against price falls in any single
208 commodity. As farming modernised and became more capital intensive, most family farms
209 specialised on either cereal farming, or pig farming, etc. to benefit from economies of scale.
210 However, specialisation increased their vulnerability to fluctuating prices. Within the next
211 Common Agricultural Policy (CAP) framework, the development of risk management tools
212 might play a significant role⁹. In the UK, future support to farmers is more likely to be based
213 on environmental land management scheme (i.e. paying farmers for habitat enhancement),
214 replacing current direct payments to farmers in England¹⁰. Risk management tools might
215 become even more important for UK farmers too. Data analysis can play a significant role in
216 developing new insurance products. Algorithms can be developed to look at the precise
217 correlations between each commodity over time and help to accurately forecast future price
218 risk.

219 Challenges

220 The above examples demonstrated how data are benefiting the AgriFood sector, however,
221 there are still a number of road blocks or difficulties in achieving a wider adoption of
222 digitalisation. These challenges were discussed during the event described above, “Turning
223 Data into Decisions 2017”, and summarised below.

224 Variety of data types

225 The depth and breadth of data needed to predict events, assess risks accurately and make
226 decisions are huge. Available data form a multi-disciplinary matrix from soil and weather

227 conditions and animal-related observations to product quality and consumer preferences.
228 Analysing and using such diverse data sets is challenging. Moreover, diverse data sources
229 collated over long periods of time are often needed. This time factor brings potential
230 problems of changing relevance (*e.g.* crop varieties) and context (*e.g.* climate change). A
231 further challenge is how to link user experience and qualitative factors so that agricultural
232 decision-making is based on a data driven system.

233 Inter-operability of data sets

234 The potential of connectivity between systems is being constrained by a lack of common data
235 standards or easy-to-use ontologies. Therefore, extraction of value becomes expensive and
236 time-consuming. The collation of data can be very challenging, particularly where
237 management decisions or control systems need inputs from multiple sources. A comparison
238 could be made with the telecoms or air traffic control sector, where very rigorous
239 international standards have existed for many years, defined in terms of both the data format
240 and terminology to allow interoperability.

241 Standardisation of data acquisition and analysis will help to integrate different data sets and
242 create more value. The FAIR principles were first published in 2016¹¹ and have since been
243 widely adopted, requiring data to be Findable, Accessible, Interoperable, and Re-usable.

244 The GODAN report sets the goal of a ‘Global Data Ecosystem’, which means amassing
245 varied and pertinent datasets in a way that allows straightforward access to and use of the
246 data. Until recently there has been wide acknowledgement of the potential, but little progress
247 in bringing together fragmented data infrastructures. There is some way to go to ensure that
248 the FAIR principles are at work in the AgriFood sector.

249 It is not clear whether one widely accepted data standard or multiple standards would be
250 more effective. A consistent approach to areas such as data terminology, structure,

251 provenance and interoperability could enable better handling and transfer of data across the
252 AgriFood system and develop trust and transparency in the sector. There is a question
253 whether an industry or a government gatekeeper could or should be in place for these
254 standards.

255 Silo-mentality

256 There is a flow of heterogeneous data, information and knowledge through the network of
257 individual sectors that comprise AgriFood, which are traditionally stored in ‘silos’. A ‘silo
258 mentality’ means that the potential to create value from synergies arising from sharing and
259 collaborating is not realised.

260 This can be attributed to the wide range of people and organisations involved in the supply
261 chain. There are the ‘doers’ who create, move and process commodities and generate new
262 technological solutions (private companies from start-ups through to international agri-tech
263 companies; farmers from smallholders through to large estates). There are the ‘influencers’
264 who set out protocols and standards, provide ethical and legal frameworks and are involved
265 in communication and knowledge transfer (government policy-makers, the media, academic
266 researchers, agricultural advisers); and, in fact, everyone is involved as food consumers.

267 Value of innovations

268 In order to encourage companies and individuals to collect and exchange data, it is critical to
269 demonstrate its value. Whilst distinct parts of the supply chain (e.g. manufacturers, retailers)
270 have the capacity to invest in research, development and innovation, most benefits from use
271 of data can be accrued at farm level. The evidence of value for the farmer is not yet clear and,
272 consequently, implementation of new technologies, which generate and analyse data is
273 limited. Farmers face significant productivity and profitability challenges, long working
274 hours and often with thin and fluctuating profit margins. When allied to historically free

275 access to numerous data sources, this means that many farmers are unclear about the business
276 rationale for investing. This can negate the capacity and enthusiasm for them to invest in
277 innovation and use of data in the first place.

278 The relatively small market and limited marketing opportunities for the services of data
279 generation, organisation and analysis (for example remote sensors feeding data, satellite
280 image analysis software, or agricultural inputs calculator), result in a number of small-scale
281 innovators finding it difficult to secure a sustainable market share. There are many start-ups
282 and technology companies operating in this market, however, 75% of them lack a visible
283 revenue model¹².

284 Current uptake tends to focus on larger progressive farms or farms in integrated supply chains
285 which have the financial capacity, interest and in-house staff expertise to take advantage of
286 the data generated. For smaller farms, the business case is seen as being uncertain. The
287 challenge, therefore, is to support key stakeholder groups to realise the value of data, which
288 will enable them to prioritise investment in areas that make the biggest difference to their
289 businesses; and share knowledge with those that do not have the capacity to invest.

290 Skills gap

291 One of the key barriers to adoption is the accessibility of these technologies to different
292 stakeholders in the AgriFood sector. The skills available to implement and fully exploit the
293 use of data driven technologies is constrained and there is a lack of instructors and teaching
294 resources to deliver appropriate training. There is a need for well-trained operators for
295 complex agricultural machinery which nowadays has not only GPS with machine guidance
296 and automatic steering, but a multitude of additional sensors and software, along with its
297 associated products and services.

298 Use of decision support tools and willingness to share data

299 As shown above in the example on improving efficiency in livestock production, real-time
300 data-based decision-support tools can help to optimise management strategies and improve
301 efficiency. There is a lack of commercial and widely acknowledged decision support tools
302 that can help to demonstrate the advantages of using big data. In addition, this is limited by
303 willingness to share the data especially when developing decision support tools that span
304 several points in the supply chain.

305 However, it is unclear whether the attitudes of data owners or the lack of opportunities to
306 share are more limiting. There is a fast-developing issue over the ownership of data and
307 liability. A fear of erosion of competitive advantage was one reason suggested for the
308 perceived reluctance to share data. In more collaborative agricultural systems, such as the
309 Netherlands, where farmers and the food chain are focused on collaborating to drive exports,
310 it is more common to share data in benchmarking groups and similar voluntary structures.
311 Sharing of risk and reward in the food chain was a perceived major constraint for many
312 farmers adopting digitalisation as they were afraid that any improvements in performance
313 would be quickly captured by other players in the supply chain. It was felt that the incentive
314 for being an innovator was unclear to many farmers.

315 Trust in data

316 One challenge is to provide industry with the confidence that the technology and data can be
317 trusted. Reliability of data (data quality and integrity – both perceived and actual) is still an
318 issue as the quality control of the mechanisms generating and organising the data may
319 sometimes be questionable. Clear legislation and regulation are essential, but not necessarily
320 in place.

321 What do we need to do now to unlock the benefits?

322 This was another question discussed during the event “Turning Data into Decisions 2017”.

323 Over 70 participants worked in different groups to discuss what is needed to make use of data
324 more widespread in the AgriFood sector.

325 The suggestions below are not new in a sense that a number of other papers were published
326 on this subject^{1,3,12}. However, the aim of the event was not only to discuss the challenges and
327 the way forward, but also to get a buy in from stakeholders through discussion and facilitate
328 future collaborative working on realising some of these suggestions. This workshop was well
329 represented and the conclusions are well balanced with wide consultation across the
330 community.

331 Data standards

332 As data standards become harmonised, there will be greater transparency and understanding
333 of data provenance, quality and integrity. This will help to develop trust and build consensus.

334 Equity

335 It is essential to avoid solutions where the big players get richer and the small players suffer.
336 Those groups who are developing solutions must allow all stages of the supply chain to ‘win’.
337 Such solutions will build trust throughout the supply chain and encourage participation in the
338 sharing of data.

339 Evidence

340 The investment in data collection and processing will be relatively expensive. In order to
341 avoid waste of resources, there should be a considerable effort in building an evidence-base
342 including an analysis of user needs. In this way, the expected outcomes from the technology
343 will be well aligned with the problems facing the industry.

This paper discusses what opportunities exist to derive value from data and how data could drive decision-making in AgriFood sector. Collecting examples of these “use cases” provides valuable evidence that can help to close the gap between the decision support tools and implementation of big data. Without evidence, there will not be enthusiasm to develop new things. Without new things, there will be no evidence. What should we do first? Bold players have already seen the potential and built some new things, so the evidence should be gathered from what already exists. As the situation develops, there should be a continuing energy in cataloguing and demonstrating what works. This will lead to enhanced storytelling (as discussed below).

Regulation

Clear legislation and regulation on data privacy, storage, sharing and utilisation, are essential to overcome the barrier of low trust towards data practices. Data must be handled ethically and transparently, with clarification of the role of the owners and handlers of data platforms and defining the exact deliverables and benefits to producers. The conditions (or licensing) for reuse of data need to be clear with rigorous data management and quality assurance³.

Reinforcement

Cultural barriers to openness in such a rich and diverse environment remain solid in places. To help to overcome these barriers, it will help if there is positive reinforcement through accreditation, or payment for associated services. Incentives to producers for investing in data collection, analysis and subsequently sharing are required, although these may not be restricted to monetary ones. Other means of reward can be the provision of real-time advice for quick decision-making applications, farm benchmarking and identification of strengths and weaknesses, and/or periodical performance records to assess efficiency.

367 Innovation support

368 There should be facilitation of engagement between data producers and partners who have or
369 can develop analytics, visualisation and decision support tools. Innovation in the use of data
370 in AgriFood could be incentivised through competitions and start-up incubation³ and greater
371 access to data funded by the taxpayer, e.g. government data.

372 Practical support

373 Capacity should be built across the sector through training, workshops and the development
374 of assets that help people learn how to use relevant data. Such support should cover:
375 developing good practices; guidelines, workflows and tools for publishing and linking data;
376 making the process of data sharing easy and well supported³.

377 Long-term commitment

378 There should be appropriate support to help organisations sustain their data resources,
379 services and capabilities, ideally bringing private resources in line with public e-
380 infrastructure. The sustainability of services will depend on brokering either government or
381 private sector ongoing support³.

382 Storytelling

383 To promote engagement, there needs to be a high visibility of example and success stories
384 involving data in AgriFood. All channels should be explored, for example: government links;
385 advisory organisations; the media; farmers' co-operatives; academic institutes; and related
386 industries³. A crucial role is to help organisations working on complementary efforts be
387 aware of each other, as well as providing gap analysis on missing initiatives (an area in which
388 SCI and the KTN are attempting to add value through the publication of this paper).

389 Governmental participation

390 There is a significant role for government departments and regulatory bodies to lead by
391 example. UK has already taken steps to coordinate the appropriate developments. Initially,
392 several UK Government Departments published the ‘UK Strategy for Agricultural
393 Technologies’¹³, leading to the formation of Agrimetrics, the Agri-Tech Centre driving
394 ground-breaking solutions from a range of valuable data sources influencing how we
395 produce, supply and ultimately consume food. In another example, the UK Food Standards
396 Agency (FSA) uses data to identify and addressing food safety risks, and applies legislative
397 and non-legislative tools to influence business behaviour in the interests of consumers and
398 working closely with the food industry. Their portal¹⁴ holds a range of valuable data about
399 food and food safety including food hygiene ratings, allergy alerts, food contaminants and
400 residues, novel foods and GM labelling, animal welfare incidents etc., all of which can be
401 used without charge by any external organisations to add value to their business and by
402 consumers to guide decision-making.

403 Industrial leadership

404 In the UK, there are organisations and initiatives such as the Open Data Institute, the FSA,
405 Agrimetrics and the Digital Systems Catapult providing leadership and direction. The ‘Made
406 Smarter Review’, led by Professor Juergen Maier, supported by over 200 organisations across
407 the UK, provided analysis of the benefits of digitalisation across all sectors of the UK
408 economy¹⁵. “Made Smarter” identified that digital technologies offer the potential for
409 substantial gains in UK food chain productivity (on p. 155 there is a reference to
410 “Digitalisation will secure the future of food supply chains”). The review also identified that
411 in some technology areas the UK is already a global leader e.g. food and refrigeration
412 monitoring systems via IoT, food safety and traceability systems, with the potential to unite

413 UK food sector expertise with UK IoT and block chain expertise to create globally leading
414 disruptive technologies.

415 [Keeping an international view](#)

416 The “Turning Data into Decisions in AgriFood” meeting in November 2017 had a UK focus,
417 but the problems and solutions are common to other countries. The European Commission is
418 providing a framework for developing actionable plans to support digitalisation in industry,
419 such as the Digitising European Industry initiative (DEI), which produced sector specific
420 plans for how digitalisation could add value in various industry sectors, including one for
421 AgriFood. DEIs vision for the future is one of increased connectivity and interoperability
422 between platforms, whereby more services could be provided through gathering and
423 combining information from a wide range of smaller platforms gathering data from sensors,
424 machinery, animals, etc. This would increase resilience within farming, e.g. to manage
425 resource efficiency, health and welfare of animals, and it could also be used to decrease
426 bureaucracy for farmers¹⁶. Examples of other international initiatives include those led by
427 Wageningen University and Research (Netherlands)^{1,2,17}, INRA (France)¹⁸, Agroknow
428 (Greece and Belgium)¹⁹, and AgGateway (USA)²⁰. International organisations and initiatives
429 supporting the digitalisation of AgriFood sector include GODAN, CGIAR, and FAO (with a
430 dedicated Interest Group on Agricultural Data).

431 [Forward look](#)

432 The above measures and activities open opportunities for specialist data integration and data
433 analysis business that can help to “fine-tune” data delivery channels, customise data delivery
434 to various customers, develop new business models, shorten supply chains, develop new
435 services and products, and give more control to food producers and customers. These actions
436 can change the balance of power in the AgriFood supply chain.

The future will be bright if the power of private-sector innovation and idea generation can be harnessed with public-sector support and in a form of public-private partnerships. The challenges are similar in all sectors of AgriFood (e.g. resistance to technology uptake, data kept in silos, inconsistent standards) and there are similarities in the underlying solutions across sectors. Data-driven agriculture feeds into many societal agendas, such as sustainability, climate-change responses, food pricing and rural economic development. The UK has already taken steps to coordinate the appropriate developments and outlined the actions that need to be taken¹⁵.

The Data Revolution is underway, we already use data, but in a piecemeal and fragmented way. The real benefits will not be realised until the leaders of today are able to bring together the disparate groups into a cohesive whole.

Acknowledgments

The authors would like to thank SCI and KTN for organising the event on 22 November 2017 at SCI Headquarters in London, and speakers and discussion leaders for providing material discussed in this publication.

Glossary

Big Data

Massive volumes of probably complex data acquired in real time from diverse sources subjected to powerful and innovative modelling and analysis to create valuable information.

Cloud computing

The use of a network of remote servers hosted on the Internet, which provide a shared pool of computer resources to store, manage and process data.

459 Decision support tools

460 Usually software-based interactive systems using specific and often diverse data to make
461 evidence-based recommendations to help users make better decisions.

462 Digitalisation

463 Enabling, improving and/or transforming systems and operations by leveraging digital
464 technologies and a wider use of digitised data to create valuable information.

465 Internet of things

466 The connections via the Internet of computers and sensors embedded in machines and other
467 devices allowing the collection and exchange of data.

468 Machine learning

469 The ability of computers and the devices they control to autonomously and continuously
470 improve their capabilities as a result of data they collect and process.

471 Open data

472 Data that anyone can access, use, modify and store free of charge, but subject to attributing
473 sources and preserving openness.

474 Remote sensing

475 The detection and/or identification of objects or landscapes from various distances without
476 direct contact.

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